

**Table 6 – Driving History**

Project	Location	Product ID	Length (# of Piles)	Hammer	Helmet	Shoe
Test 1a	DE	12-2	60' (1)	MKT9B3 (air)	none	Hollow
Test 1b	DE	12-3	60' (2)	MKT9B3 (air)	none	Hollow
Test 2a	DE	12-3	20' (1)	ICE30S (diesel)	std. pipe pile head	Flat plate
Test 2b	DE	12-3	45' (1)	ICE30S (diesel)	std. pipe pile head	Flat plate
Cape May-Lewes Ferry Terminal	DE	12-3	65' (18)	ICE812 Vibro	Timber clamp	Hollow
FL Meyers Commercial Piers	FL	18-3	55' (27)	Delmag D-12	std. pipe pile head	Hollow
Private Marina	WA	12-3	39' (3)	Drop hammer	std. pipe pile head	Conical
Atlantic Highlands Marina	NJ	12-3	30' (30)	ICE520-30	Sheet pile head	Flat sheet
Atlantic Highlands Marina	NJ	12-3	40' (10)	ICE520-30	Sheet pile head	Flat sheet
Delaware River and Bay Authority	DE	18-4	70' (55)	ICE 416 Vibro	std. pipe pile head	Hollow
Delaware River and Bay Authority	NJ	MP-60 <sup>3</sup>	80' (1)	ICE4430 (diesel)	Steel mandrel	Hollow
Delaware River and Bay Authority	NJ	MP-72 <sup>3</sup>	80' (1)	ICE44 Magn. (diesel)	Steel mandrel	Hollow
Asbury Park Outfall	NJ	18-3	28' (38)	Not yet driven		
Asbury Park Outfall	NJ	18-4GC <sup>4</sup>	27' (66)	Not yet driven		
Long Branch Outfall	NJ	18-3	24' (64)	Berning-hammer 3505 (diesel)	Steel mandrel	Conical
Long Branch Outfall	NJ	18-4GC	27' (104)	Berning-hammer 3505 (diesel)	Steel mandrel	Conical

<sup>3</sup> 60" and 72" diameter Monopile<sup>4</sup> Glass/Carbon fiber hybrid





## SPECIFICATION DATA

### SPECIFICATION FOR FRP COMPOSITE PILES

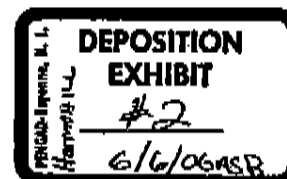
#### 1. DESCRIPTION

- 1.01 This work shall consist of furnishing and installing FRP Composite Piles. This work will include all equipment, materials, labor and all else necessary to install the piles as shown on the plans. See plan documents for a pile schedule specifying quantity, diameter, length and other requirements unless included in specification.

#### 2. MATERIALS

##### 2.01 FRP Composite Tube

- A. FRP composite tube shall be fabricated of high-strength, fiber-reinforced composite materials by means of VARTM (Vacuum Assisted Resin Transfer Molding). The piles shall be manufactured with vinyl ester resin and stitch bonded fabric reinforcement. The minimum fiber content by volume shall be no less than 50%. Composite tube shall meet all material and performance specifications cited in this document. Composite tube shall be produced by Hardcore Composites (New Castle, DE) or Engineer pre-approved equal.
- B. FRP Composite tube shall be coated with either a minimum 6 mil thick epoxy coating or a minimum 30 mil thick acrylic coating depending on the project requirements. [Engineer to specify].
1. Epoxy Coating (standard). Coating shall be no less than 6 mils in dry film thickness and offer the following material properties. The coating shall achieve a direct impact resistance rating of no less than 95 psi using ASTM D2794. The abrasion resistance shall be no less than 80mg loss per ASTM D4060 using a CS17 wheel at 1000 cycles at a load of 1 kg. The pencil hardness of the coating shall achieve a minimum rating of F-H per ASTM D3363. The Salt fog resistance shall show no cracking, softening, or delamination per ASTM B117 at 750 hours.
2. Acrylic Coating. Coating shall be no less than 30 mils in dry film thickness and offer the following material properties. The water absorption weight gain for a 24 hour immersion is than 0.4 percent per ASTM D-570. The water permeability at 37.5°C and 100 percent relative humidity is 20.3 (g-mil)/(100 in<sup>2</sup> \* day). The gas permeability of O<sub>2</sub> at 23°C and 0 percent relative humidity is 33 (cc-mil)/(100 in<sup>2</sup>\*atm\*day). The Izod Notched impact resistance is 1.1 ft-lb/in. of notch at 73°F and 0.44 ft-lb/in. of notch at 32°F per ATSM D-256.



**FRP COMPOSITE PILES**

- C. FRP composite tubes shall be manufactured with a textured, inner surface. The textured surface will provide a mechanical lock between the tube and filler material, typically concrete. This mechanical lock will minimize slippage between the composite tube and filler material.
- D. FRP composite tubes shall have a minimum wall thickness as follows:

PRODUCT IDENTIFICATION	NOMINAL O.D. (in) $\pm 0.5"$	WALL THICKNESS (in)
10-2	10	0.182
12-2	12.75	0.182
12-3	12.75	0.273
14-3	14	0.273
18-3	18.13	0.273
18-4	18.13	0.364
24-3	24	0.273
24-4	24	0.364

**2.02 Concrete Infill**

- A. Concrete infill for FRP Composite Piles shall conform to applicable state or federal specifications.
- The 28 day compressive strength shall be no less than 4,000 psi.
  - Non-shrink admixtures shall be utilized in the mix design to assure that a mechanical lock is established between the composite tube and concrete infill.

**2.03 FRP Composite Pile**

- A. The FRP Composite Pile, including 4,000 psi compressive strength concrete infill, shall offer ultimate stiffness and moment capacities as shown in the table below.

PRODUCT IDENTIFICATION	NOMINAL O.D. (in)	BENDING STIFFNESS <sup>1</sup> , EI (lb-in <sup>2</sup> )	BENDING MOMENT <sup>2</sup> (in-lb)
10-2	10	$4.49 \times 10^8$	$1.15 \times 10^6$
12-2	12.75	$9.78 \times 10^8$	$2.04 \times 10^6$
12-3	12.75	$1.38 \times 10^9$	$2.80 \times 10^6$
14-3	14	$1.76 \times 10^9$	$3.43 \times 10^6$
18-3	18.13	$4.59 \times 10^9$	$5.66 \times 10^6$
18-4	18.13	$5.78 \times 10^9$	$7.60 \times 10^6$
24-3	24	$1.05 \times 10^{10}$	$1.01 \times 10^7$
24-4	24	$1.34 \times 10^{10}$	$1.29 \times 10^7$

- Bending stiffness calculated at 20% of ultimate bending moment
  - In practice, piling should not be used at its ultimate moment capacity. A factor of safety should be used. It is recommended that piling be stressed up to 20% of ultimate moment capacity. However, the appropriate factor of safety may vary at the designer's discretion for particular applications.
- \* 24 inch diameter pile flexural data based on extrapolation of experimental data.

## **FRP COMPOSITE PILES**

### **3. CONSTRUCTION DETAILS**

- 3.01 FRP Composite Piles shall be installed using industry standard methods including impact hammers, vibratory hammers and jetting. The piles shall be driven either hollow or with concrete infill depending on the site-specific geotechnical conditions. The piles can also be driven either open ended or with a driving shoe as provided by Hardcore Composites. A standard pipe pile driving helmet or equivalent is used in most applications. [The method of installation and maximum allowable driving stresses shall be specified by the Engineer of Record].
- 3.02 Once the piles are installed, piles shall be cut at the cut-off elevation shown on the plans. Cutting shall be performed by sawing or other means as approved by the Engineer of Record to provide a smooth level cut.
- 3.03 Depending on the physical properties required, piles may be left unfilled. If the project requires the piles be filled, soil and water shall be removed from the inside of the pile to below the point of fixity or as specified by the Engineer of Record. Concrete shall then be tremmie placed into the pile in a manner approved by the engineer. [Engineer to determine whether filled or unfilled piles are required].
- 3.04 When submitting shop drawings for approval, the provisions of the applicable state or federal specifications shall apply, with the following modifications:
- A. The Contractor shall submit the following shop drawings and supporting information for approval:
    - i. Proposed FRP composite tube, including bending stiffness and bending moment, concrete specification and certification of compliance with this specification.
    - ii. Proposed concrete mix design, verifying compressive strength and shrinkage compensation.
    - iii. Details for driving helmets, cap blocks and pile cushions and recommendations for pile driving equipment.
    - iv. Handling, transporting and storing recommendations for composite piles.
    - v. Proposed concrete supplier.

### **4. METHOD OF MEASUREMENT**

The quantity of piles to be paid for under the work specified for FRP Composite Piles will be the number of linear feet of piles placed in the leads, and installed in accordance with the plans and this specification. No additional measurement for payment will be made for redriving of piles that are forced up by any cause.

### **5. BASIS OF PAYMENT**

**FRP COMPOSITE PILES**

5.01 The unit price bid per linear foot for each of the respective FRP Composite Pile items shall include the cost of furnishing all labor (including the manipulation of pile driving equipment and materials), materials, and equipment necessary to complete the work as prescribed in these specifications. No payment will be made for piles rejected in accordance with the requirements listed under sections regarding Defective Piles of the applicable state or federal specifications.

5.02 Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Pay Unit</u>
10-2	FRP Composite Pile (2-ply), 10" Dia.	LF
12-2	FRP Composite Pile (2-ply), 12" Dia.	LF
12-3	FRP Composite Pile (3-ply), 12" Dia.	LF
14-3	FRP Composite Pile (3-ply), 14" Dia.	LF
18-3	FRP Composite Pile (3-ply), 18" Dia.	LF
18-4	FRP Composite Pile (4-ply), 18" Dia.	LF
24-3	FRP Composite Pile (3-ply), 24" Dia.	LF
24-4	FRP Composite Pile (4-ply), 24" Dia.	LF



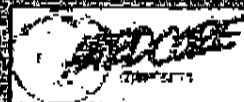
**Hardcore Composites**  
618 Lambsons Lane / New Castle, DE 19720  
Phone: 302.442.5900 / Fax: 302.442.5901  
[www.hardcorecomposites.com](http://www.hardcorecomposites.com)





# Hardcore Composites

## Hardshell Composite Pile Strengthening Jackets



...the use of large-scale composite structures...



## Applications

### Composite Jackets



#### Repair of Timber Piles

- ◆ Provides structural strengthening and restores lateral and vertical load carrying capability



- ◆ Ideal when overdriving with hollow pile is not possible due to the presence of super structure.

### Seismic Upgrade of Concrete Bridge Columns

Hardshell Composite Pile Strengthening Jackets have been tested and approved by Caltrans for seismic upgrade retrofits of concrete bridge columns. This system provides an effective method of adding structural hoop confinement where seismic instability is a concern.



#### Containment & Protection

Hardcore FRP Composite Shells are an excellent form in which to pour grout when a badly deteriorated concrete or steel structural member needs repair. In such cases, the composite shell offers the additional benefit of enhanced structural performance, long term impact / abrasion, protection and an aesthetically pleasing appearances.



## Advantages

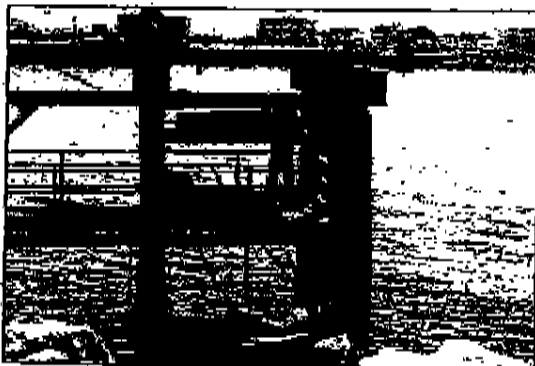
### Composite Jackets

#### Prefabricated Quality Assurance

Prefabricated composite shapes provide consistent, repeatable strength and quality that is not dependent on site fabrication labor.

#### Superior Strength Characteristics

Vacuum infusion manufacturing process yields extremely high fiber volume content, providing more than twice the strength capabilities of conventional wet lay-up processes. Factory quality control assures that specified fiber and strength orientation is achieved before the shapes leave the plant.



#### Marine Installation

Unlike traditional "wet wrap" methods that are not feasible for marine applications, the easy to install prefabricated Hardcore Composite Shells can be installed below the water line. This makes marine protection and rehabilitation projects much more cost effective.

#### Offset Capability

The uniqueness of Hardcore Composite Shapes permit offset positioning on columns to repair a variety of structural surface contours including damaged or uneven substrates.

#### Rapid Installation

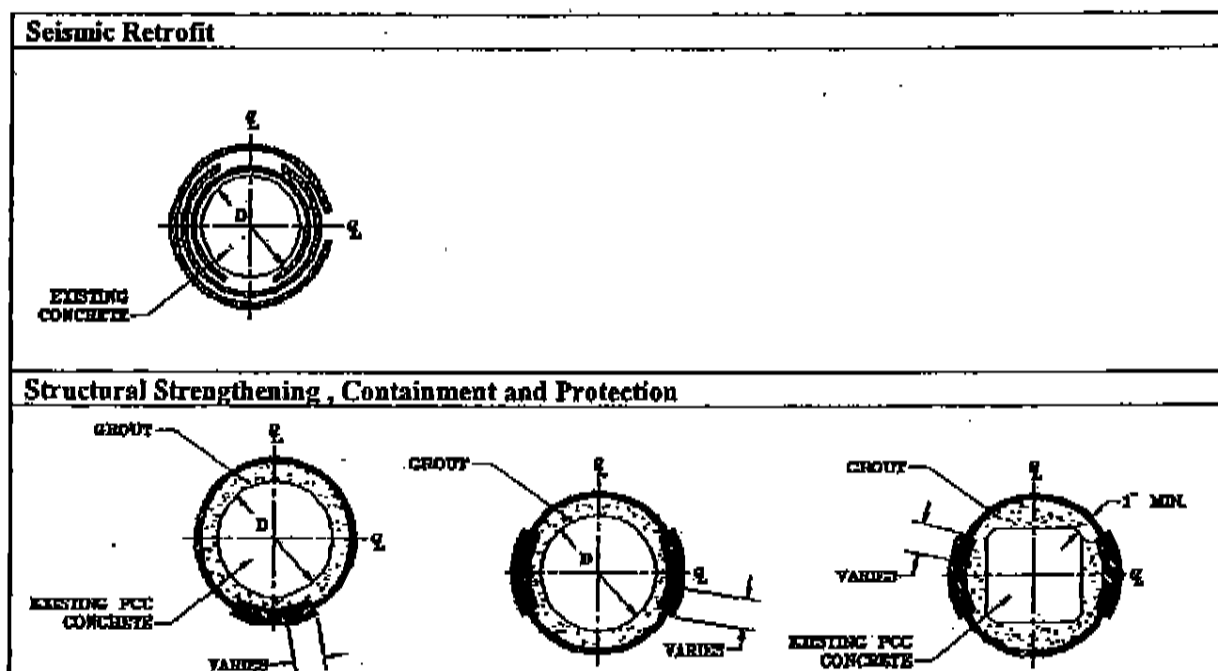
A complete installation can take as little as a few hours to accomplish, making the Hardcore Composite System an ideal solution for fast track repair projects.

#### Corrosion Protection

Composite jackets provide a barrier to the intrusion of moisture to the substrate that is particularly effective in the splash zone.

## Specific Details and Installation

### Standard Details



\* Custom shapes and sizes are available

### Installation Sequence

#### 1. Prepare Column

Before installation of the Hardcore Composite System, the underlying concrete must be free of defects or corrosion. Perform any necessary repairs.



#### 3. Position Jackets

Once the gasket seam of the Hardcore shell has been coated with epoxy adhesive, it is stretched open and positioned. Depending on the design objectives, multiple overlapping jackets may be installed.

#### 2. Apply Adhesive

For offset installations, adhesive is applied to the connector seam. For applications where the jacket is designed to be installed in direct contact with the substrate, adhesive is applied to inner surface of the jacket.

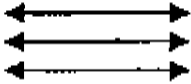
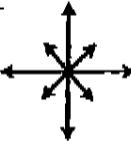



#### 4. Strap Jackets in Place

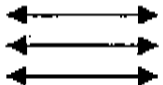
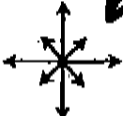


A simple belting system is cinched around the jackets and tightened for eight hours. After the adhesive has cured and grout (if specified) is poured, the straps are removed. The composite system with factory applied aesthetic finish is ready for service.

## Factory Assured Fiber Orientation

### Shell Properties Defined by Fiber Orientation

Typical Application			
	Unidirectional Composite	Multi Axis 0 +/- 45 90 Composite	Enhanced Multi Axis 0 +/- 45 90 Composite
Composite Design Series	UM	QM	QE
Seismic Retrofit	X		
Structural Strengthening			
Shear Enhancement			X
Improved Bending Performance			X
Timber Pole Repair			X
Containment & Protection		X	
Flat Wall & Other Geometries			
Impact/Blast Resistance		X	

### Hardshell Physical Properties

Property	Reference Standard				
		Uni-Directional Composite	Multi Axis 0 +/- 45 90 Composite	Enhanced Multi Axis 0 +/- 45 90 Composite	Bi-Directional Composite
Hardshell Series		UM 2005	QM 2005	QE 2100	WP 2400
Ultimate Tensile Strength (min.) Primary Axis	ASTM D 3039	90,000 psi	63,000 psi	74,000 psi	57,800 psi
y-y Axis		10,000 psi	47,000 psi	35,000 psi	60,560 psi
Tensile Modulus (min.) Primary Axis	ASTM D 3039	5,000 ksi	3,750 ksi	4,100 ksi	3,100 ksi
y-y Axis		450 ksi	2,360 ksi	1,960 ksi	3,400 ksi
Ultimate Tensile Strain (min.)	ASTM D 638	2.0%	1.8%	1.8%	1.8%
Fiber Volume Fraction (min.)	ASTM D 3171	50%	50%	50%	50%

## Leading the World in large-scale Composite Structures

Hardcore Composites is focused on the infrastructure. Our products, systems and components are found in a diverse range of large-scale engineered structures including bridges and walkways, marine fender systems and specialty composite stay-in-place forms. Our customers include Department of Transportation (DOT), Marine and Commercial Construction interests.

Dedicated to providing the Optimum solution for our clients, Hardcore Composites employs a staff of diversified engineers with proficiency in composites, structural analysis, marine engineering and construction. This team is capable of developing engineered solution to real-world challenges. Our design build approach considers the whole construction dynamic, through each step in the critical path process—from design through installation.

We have earned a reputation for combining state of the art analytical tools and expertise with a creative approach to value engineering. The results of this are improved systems, structures that function well and are installed quickly.

***Hardcore Composites has achieved national recognition in the following areas:***



### ***Composites Institute***

1995 – Project of the Year/ Development for Marine Fenders  
1996 – Award for Excellence for Marine Fender System  
1996 – Award for Excellence for Hardshell Concrete Repair System



### ***Dow Chemical***

1997 – Fabricator Excellence Award for Magazine Ditch Bridge  
1999 – Fabricator Excellence Award for Longbranch, NJ Outfall  
2000 – Fabricator Excellence Award for Composite Monopile



### ***Delaware DOT***

1998 – Outstanding Bridge project Fabricator Award for Bridge over Muddy Run



### ***Civil Engineering Research Foundation***

1999 – Charles Pankow Award/Finalist  
Nominated by New York State DOT for Bennett's Creek Bridge  
2000 – Charles Pankow Award  
Nominated by New York State DOT for Bentley's Creek Bridge

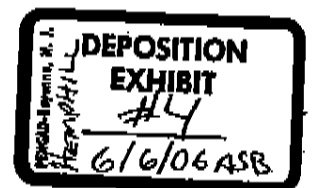
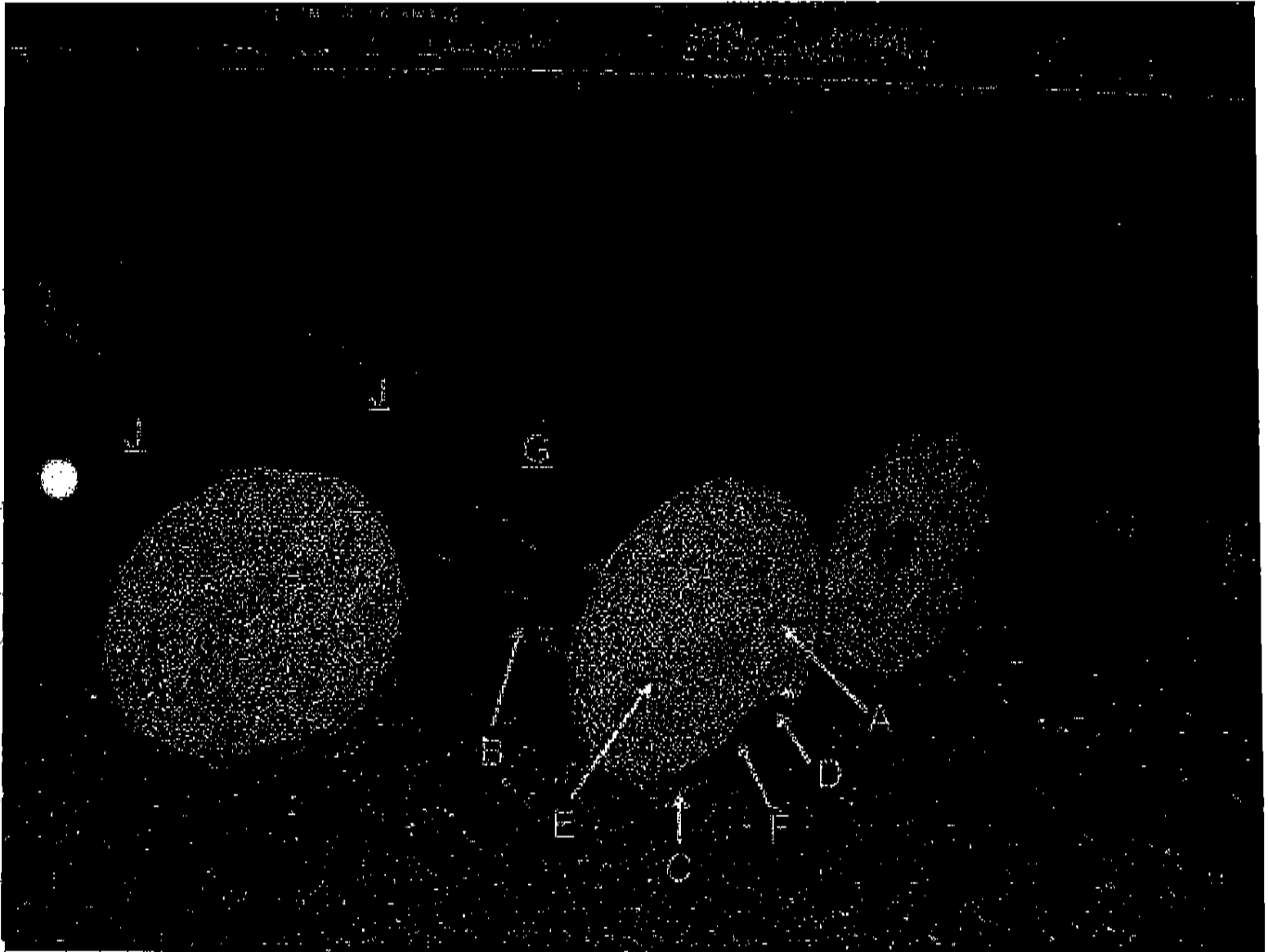


### **Hardcore Composites**

618 Lambsons Lane / New Castle, DE 19720  
Phone: 302.442.5900 / Fax: 302.442.5901  
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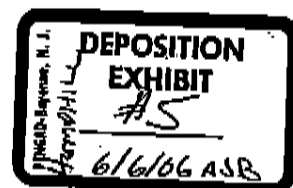
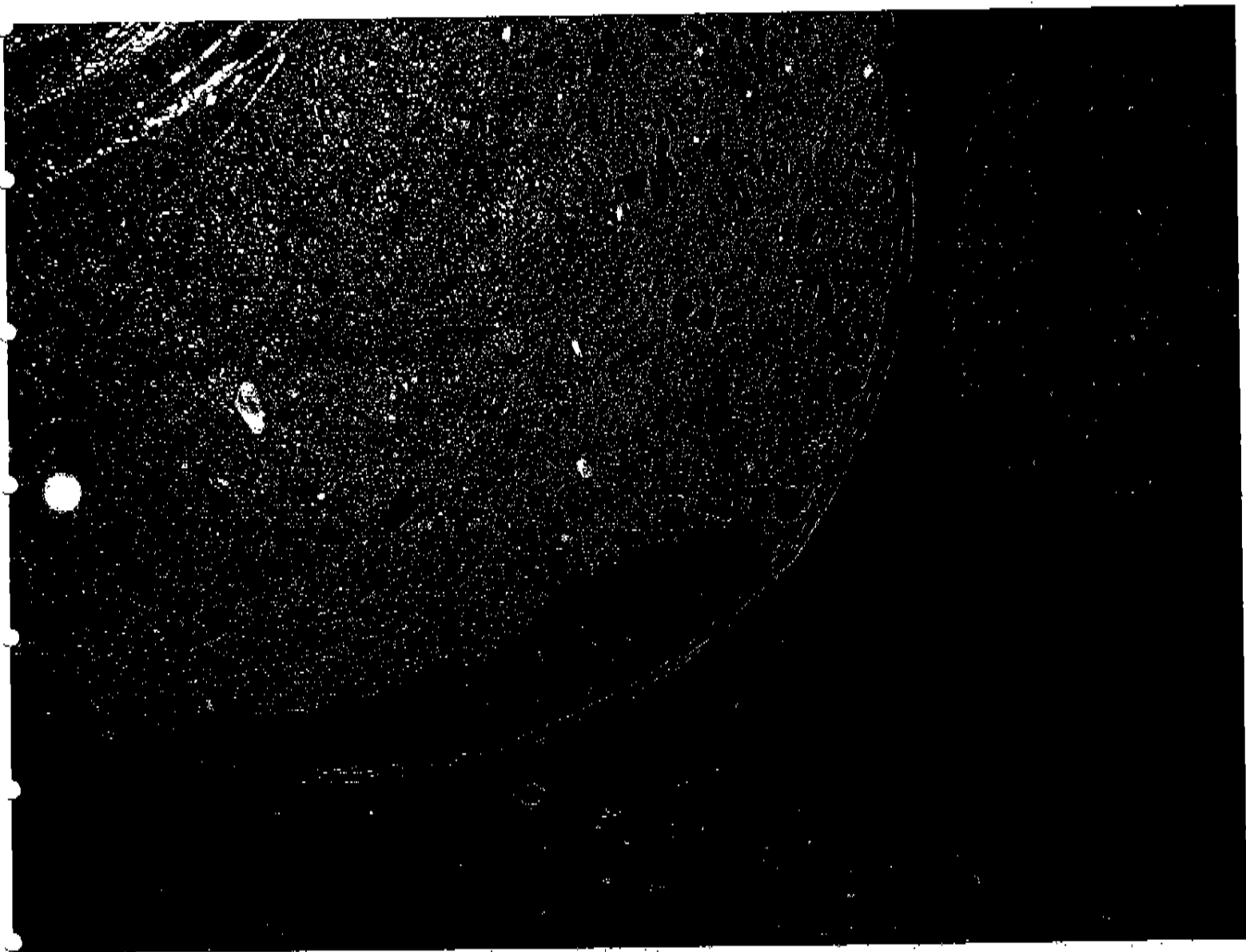
HC M004 Hardshell Jackets, August 2000







Exh. 5





Sep. 15. 2004 1:17PM-SIE E. L. C. Associates1904

TO: 197331 No. 0175 P. 2 P: 2/11



**Hardcore Composites**  
**Operations LLC**  
 618 Lambsons Lane  
 New Castle, Delaware 19720

Quote No: 0091504-1

Quote prepared by: Jeff Pote, Hardcore Composites

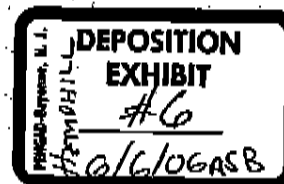
QUOTE DATE	F.O.B.	TERMS
Wednesday, September 15, 2004	Job Site	T.O.D.

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
4,485 lin. ft. (69 piles @ 65')	10" OD x 2-ply Hardcore Composite pile with 0.18" thick structural wall. Includes a 12.75" OD x 1.16" thick HDPE (high-density polyethylene) wear sleeve to protect the top portion of the pile from abrasion due to vessel contact. Pile will be filled with concrete prior to shipment to jobsite. HDPE wear sleeve will be shipped separately. Contractor must place HDPE sleeve after pile is driven to the required elevation.  Quoted pile well exceeds both the bending moment and bending stiffness (EI) of comparable diameter Lancaster Composite pile. Independent laboratory flexural test results from Lehigh University attached.	\$26.25 / ft.	\$117,731.25
10 Truckloads	Freight estimate - Extended trailers and escorts required. Pile weight is estimated at 85 lbs/ft OR 5,525 lbs/pile. Seven (7) piles per truckload.	\$1,100 / ea.	\$11,000.00
TOTAL			\$128,731.25

**NOTES:**

- 1) Quote valid for 30 days.
- 2) Sales tax extra as applicable.
- 3) Availability: To meet construction schedule.

Copy to Scott Hemphill, Hardcore Composites



Thank you for the opportunity to quote this project!

Exhibit E



**Hardcore Composites  
Operations LLC**  
618 Lambsons Lane  
New Castle, Delaware 19720  
302-472-0815 Fax 302-472-0816

Quote No. 1318

Project: [REDACTED]

To:

Quote prepared by:  
Jeff Pote

QUOTE DATE	F.O.B. POINT	TERMS
8/9/04	New Castle, DE	20% Down, Net 30 for completed, stored materials

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
3 360-lb (84 pieces @ 40-ft)	18-5 FRP Pile	[REDACTED]	[REDACTED]
4	Composite SIP Forms	[REDACTED]	[REDACTED]
SUBTOTAL			[REDACTED]
TAXES			0.00
TOTAL			[REDACTED]

- 1) Quote valid for 60 days.
- 2) All taxes extra as applicable.

Hardcore Composites Authorized Signature

Date

Exhibit D



**Hardcore Composites  
Operations LLC**  
618 Lambsons Lane  
New Castle, Delaware 19720  
302-472-0816 Fax 302-472-0816

Quote to:

1419

Project:

[REDACTED]

To:

Quote prepared by:  
Jeff Pote

QUOTE DATE	F.O.B. POINT	TERMS
7/27/04	New Castle, DE	30% Down, Net 30 upon delivery

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
2 126-ft (56 pl is @ 38-ft)	10-2 FRP Pile Piles meet minimum structural requirements as follows: - Wall Thickness 0.18-In minimum - 10-In Nominal Diameter - Exterior Coat to be Black Epoxy Paint unless customer requests a different color	[REDACTED]	[REDACTED]
40-ft (16 pl is @ 40-ft)	12-2 FRP Pile Piles meet minimum structural requirements as follows: - Wall Thickness 0.18-In minimum - 12-In Nominal Diameter - Exterior Coat to be Black Epoxy Paint unless customer requests a different color	[REDACTED]	[REDACTED]
2 126-ft (56 pl is @ 38-ft)	10-2 FRP Pile Piles meet minimum structural requirements as follows: - Filled with 6,000 psi concrete - Wall Thickness 0.18-In minimum - 10-In Nominal Diameter - Exterior Coat to be Black Epoxy Paint unless customer requests a different color	[REDACTED]	[REDACTED]
40-ft (16 pl is @ 40-ft)	12-2 FRP Pile Piles meet minimum structural requirements as follows: - Filled with 6,000 psi concrete - Wall Thickness 0.18-In minimum - 12-In Nominal Diameter - Exterior Coat to be Black Epoxy Paint unless customer requests a different color	[REDACTED]	[REDACTED]

Exhibit C

2 (Truc : Loads)	Shipping (Not Filled)		
7 (Truc : Loads)	Shipping (Filled)		
		SUBTOTAL	NA
		TAXES	0.00
		TOTAL	NA

- 1) Quote valid for 45 days.
- 2) Delivery 4-6 weeks ARO or to meet schedule
- 3) Shipping Costs to [REDACTED]
- 4) All axes extra as applicable.

\_\_\_\_\_  
Harcore Composites Authorized Signature

\_\_\_\_\_  
Date





**Hardcore Composites  
Operations LLC**  
618 Lambsons Lane  
New Castle, Delaware 19720  
302-472-0815 Fax 302-472-0816

Quote for  
1417

Products

To:

Quote prepared by:  
Jeff Pote

QUOTE DATE	F.O.B. POINT	TERMS
7/23/04	New Castle, DE	30% Down, Net 30 upon delivery

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
5, 48.5-ft (45 piles @ 85-ft 40 piles @ 63-ft 1 pile @ 3.5-ft)	18.5-In FRP Pile Piles meet minimum structural requirements as follows: - Bending Stiffness (EI) of $2.75 \times 10^9$ lb-in <sup>2</sup> - Piles to be filled with 6,000 psi concrete - Wall Thickness 0.25-in minimum - Exterior Coat to be Black Epoxy Paint unless customer requests a different color - Straightness to be less than 1.25-in per 10-ft		
85	Heavy Duty Driving Tips for Piles		
3 (Tie & Loads)	Shipping		
SUBTOTAL			
TAXES			0.00
TOTAL			

- 1) Quote valid for 45 days.
- 2) Delivery 12 weeks ARO
- 3) Shipping Costs to Florida
- 4) All taxes extra as applicable.

Hardcore Composites Authorized Signature

Date

Exhibit B

Exh. 7



August 7, 2003

S 03 - 0374

E/ 7827

Tim Linden  
Orion Construction  
T: (813) 839-8441  
F: (813) 831-7498

**Re: Pler 12 San Diego**

Thank you for the opportunity to provide the following quotation.

<u>Product</u>	<u>Reinforcement</u>	<u>Qty.</u>	<u>Length</u>
<b>FIBERGLASS MARINE FENDER PILES</b>			
<b>HARDCORE COMPOSITE Fender Piles - Option A</b>			
12.75" OD x .027" wall Fiberglass Marine Fender Piles that meet spec requirements, including: vinyl ester resin, triaxial e-glass fabric, inner polyethylene layer, and manufactured using closed resin infusion process.		74 each	60.00 ft
<b>Total delivered CIF to San Diego, CA:</b>			<b>\$162,350</b>

**HARDCORE COMPOSITE Fender Piles - Option B**

12.75" OD x 0.27" wall Fiberglass Marine Fender Piles that do not meet all spec requirements.	74 each	60.00 ft
<b>Total delivered CIF to San Diego, CA:</b>		<b>\$121,280</b>

The above quoted piles are hollow. Contractor will have to precast with concrete. High Density Polyethylene Pipe Sleeves called for Section 02463, Subsection 2.3.2.1 can be ordered directly from the distributor in California. Please contact P&F Distributors @909-396-6887. We recommend the 16" OD, DR 13.5 (13.63" ID)

Sales tax: Applicable taxes are not included in the above pricing.  
Delivery: To suit construction schedule.

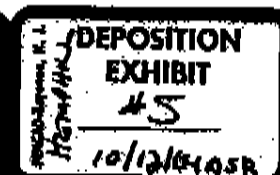
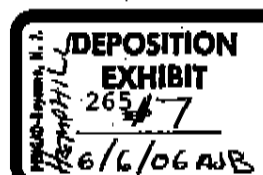
We look forward to the opportunity to work together with you on this project. Please advise should you have any questions or require additional information.

Yours sincerely,

*Bryan Maphis*  
Bryan Maphis



SEAWARD, a division of Trelleborg Engineered Products, Inc., 3470 Martinsburg Pike, P.O. Box 98, Clearbrook, VA 22624, USA  
Phone (540) 667-5191 Fax (540) 667-7987 E-Mail mail@seaward.com Internet www.seaward.com







TO: 19733150218

P: 1/11

**Date:** 9/15/04**To:** Bob Schmidt, E.L.C.  
Phone: 973-315-0200  
Fax: 973-315-0218**From:** Steve Shannon  
Phone: 717-625-3740  
Fax: 717-625-3741**Pages:** 11**Subject:** Hardcore Composite Fender Pile Quote  
South Jersey Port - Piers 1 & 1a**Bob:**

Thank you for taking time to talk with me this morning. For your review, I have transmitted the following:

- HC Pile Quote (1 pg.)
- HC Pile Design Guide (4 pgs)
- Lehigh University flexural test report (5 pgs)

As you will see, the delivered price is \$28.70 per lineal foot. That price includes the required HDPE wear sleeve for abrasion protection. Please note, the flexural properties (bending moment and bending stiffness-BI) of the quoted Hardcore Composite Pile well exceed a comparable sized (O.D.) Lancaster Composite pile.

Thanks again for the opportunity to quote this project. Please call me with any questions.

Best Regards,

STEVE  
7

267

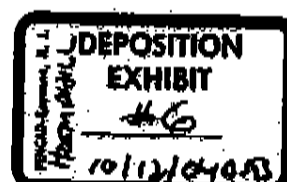
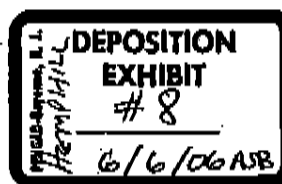


Exhibit D

**US Patent No. 6,048,594**

Claims as issued	<u>Hardcore Product</u> (Call out letters correspond to attached Hardcore Specification Data, Composite Tubular Piling Design Guide, Hardcore Composite Pile Strengthening Jackets Document and Photo of Hardcore Product)
1. A filled structure characterized by the combination of high compressive strength and tensile strength to allow a high bending load, the filled structure comprising:	Photo shows and Specification Data and Composite Tubular Piling Design Guide specifies a 4000 psi compressive strength concrete infill (A) with a high tensile strength, fiber reinforced composite tube (B). High bending load is specified. See bending moment specifications (H).
a fiber reinforced resinous hollow structure having a tensile strength of at least 30,000 psi, and	Photo shows and Specification Data and Composite Tubular Piling Design Guide specifies a fiber reinforced composite tube (B). Hardcore Composite Pile Strengthening Jackets Factory Assured Fiber Orientation (C) specifies an ultimate tensile strength of 63,000 psi.
an inside surface forming a boundary which defines a space, and	Photo shows and Specification Data and Composite Tubular Piling Design Guide specifies, at (D), FRP composite tubes having various outside diameters and wall thicknesses forming a boundary which encloses a space.



<p>a hard core within said space, the hard core having a density of at least 35 pounds per cubic foot and a compressive strength of at least 1500 psi,</p>	<p>Photo shows and Specification Data and Composite Tubular Piling Design Guide specifies a concrete infill as a hard core (E). Specification Data and Composite Tubular Piling Design Guide (E) specifies the concrete infill having a compressive strength of no less than 4,000 psi. It is well known that concrete has a density which far exceeds 35 pounds per cubic foot. Typical density is in the range of 140 -145 pounds per cubic foot.</p>
<p>the hard core being formed from a mixture of particulate cementitious material and liquid such that when said mixture hardens, said hard core is joined securely to said inside surface of said hollow structure.</p>	<p>Concrete specified for the infill is well known to be a mixture of particulate cementitious material and liquid. Photo shows and Specification Data at (E) (F) specifies the concrete infill being mechanically locked to the composite tube.</p>
<p>2. The filled structure of claim 1, wherein said mixture is such that it expands its volume as it hardens, expansion of the mixture being restrained by the hollow structure and the hard core exerts a force against the inside surface of the hollow structure.</p>	<p>Specification Data (E) specifies the concrete infill to have non-shrink admixtures assuring that a mechanical lock is established between the composite tube and the concrete infill. Specification Data, at (I) refers to shrinkage compensation.</p>
<p>3. The filled structure of claim 1, wherein the hollow structure is a closed section.</p>	<p>Photo shows and Composite Tubular Piling Design Guide, at (D) shows a closed section of a hollow structure.</p>
<p>4. The filled structure of claim 1, wherein the hollow structure is a cylindrical pipe having fiberglass rovings therein.</p>	<p>Photo shows and Specification Data and Composite Tubular Piling Design Guide specifies a FRP composite tube (B) fabricated of fiber-reinforced composite material.</p>

<p>12. The filled structure according to claim 11, wherein said mixture is such that it expands its volume as it hardens, expansion of the mixture being restrained by the hollow structure and the hard core exerts a force against the inside surface of the hollow structure.</p>	<p>Specification Data (E) specifies the concrete infill to have non-shrink admixtures assuring that a mechanical lock is established between the composite tube and the concrete infill. Specification Data, at (I) refers to shrinkage compensation.</p>
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## SPECIFICATION DATA

### SPECIFICATION FOR FRP COMPOSITE PILES

#### 1. DESCRIPTION

- 1.01 This work shall consist of furnishing and installing FRP Composite Piles. This work will include all equipment, materials, labor and all else necessary to install the piles as shown on the plans. See plan documents for a pile schedule specifying quantity, diameter, length and other requirements unless included in specification.

#### 2. MATERIALS

##### 2.01 FRP Composite Tube

- A. FRP composite tube shall be fabricated of high-strength, fiber-reinforced composite materials by means of VARTM (Vacuum Assisted Resin Transfer Molding). The piles shall be manufactured with vinyl ester resin and stitch bonded fabric reinforcement. The minimum fiber content by volume shall be no less than 50%. Composite tube shall meet all material and performance specifications cited in this document. Composite tube shall be produced by Hardcore Composites (New Castle, DE) or Engineer pre-approved equal.

- B. FRP Composite tube shall be coated with either a minimum 6 mil thick epoxy coating or a minimum 30 mil thick acrylic coating depending on the project requirements. [Engineer to specify].

1. Epoxy Coating (standard). Coating shall be no less than 6 mils in dry film thickness and offer the following material properties. The coating shall achieve a direct impact resistance rating of no less than 95 psi using ASTM D2794. The abrasion resistance shall be no less than 80mg loss per ASTM D4060 using a CS17 wheel at 1000 cycles at a load of 1 kg. The pencil hardness of the coating shall achieve a minimum rating of F-H per ASTM D3363. The Salt fog resistance shall show no cracking, softening, or delamination per ASTM B117 at 750 hours.

2. Acrylic Coating. Coating shall be no less than 30 mils in dry film thickness and offer the following material properties. The water absorption weight gain for a 24 hour immersion is than 0.4 percent per ASTM D-570. The water permeability at 37.5°C and 100 percent relative humidity is 20.3 (g-mil)/(100 in<sup>2</sup> \* day). The gas permeability of O<sub>2</sub> at 23°C and 0 percent relative humidity is 33 (cc-mil)/(100 in<sup>2</sup>\*atm\*day). The Izod Notched impact resistance is 1.1 ft-lb/in. of notch at 73°F and 0.44 ft-lb/in. of notch at 32°F per ATSM D-256.

**FRP COMPOSITE PILES**

- C. FRP composite tubes shall be manufactured with a textured, inner surface. The textured surface will provide a mechanical lock between the tube and filler material, typically concrete. This mechanical lock will minimize slippage between the composite tube and filler material.
- D. FRP composite tubes shall have a minimum wall thickness as follows:

PRODUCT IDENTIFICATION	NOMINAL O.D. (+/- 0.5") (in)	WALL THICKNESS (in)
10-2	10.00	0.182
12-2	12.75	0.182
12-3	12.75	0.273
14-3	14.00	0.273
18-3	18.00	0.273
18-4	18.00	0.364
24-3	24.00	0.273
24-4	24.00	0.364

**2.02 Concrete Infill**

- A. Concrete infill for FRP Composite Piles shall conform to applicable state or federal specifications.
- The 28 day compressive strength shall be no less than 4,000 psi.
  - Non-shrink admixtures shall be utilized in the mix design to assure that a mechanical lock is established between the composite tube and concrete infill.

**2.03 FRP Composite Pile**

- A. The FRP Composite Pile, including 4,000 psi compressive strength concrete infill, shall offer ultimate stiffness and moment capacities as shown in the table below.

PRODUCT IDENTIFICATION	NOMINAL O.D. (+/- 0.5") (in)	BENDING STIFFNESS <sup>1</sup> , EI (lb-in <sup>2</sup> )	BENDING MOMENT <sup>2</sup> (in-lb)
10-2	10.00	$4.49 \times 10^8$	$1.15 \times 10^6$
12-2	12.75	$9.78 \times 10^8$	$2.04 \times 10^6$
12-3	12.75	$1.38 \times 10^9$	$2.80 \times 10^6$
14-3	14.00	$1.76 \times 10^9$	$3.43 \times 10^6$
18-3	18.00	$4.59 \times 10^9$	$5.66 \times 10^6$
18-4	18.00	$5.78 \times 10^9$	$7.60 \times 10^6$
24-3	24.00	$1.05 \times 10^{10}$	$1.01 \times 10^7$
24-4	24.00	$1.34 \times 10^{10}$	$1.29 \times 10^7$

- Bending stiffness calculated at 20% of ultimate bending moment.
  - In practice, piling should not be used at its ultimate moment capacity. A factor of safety should be used. It is recommended that piling be stressed up to 20% of ultimate moment capacity. However, the appropriate factor of safety may vary at the designer's discretion for particular applications.
- \* 24 inch diameter pile flexural data based on extrapolation of experimental data.

## **FRP COMPOSITE PILES**

### **3. CONSTRUCTION DETAILS**

- 3.01 FRP Composite Piles shall be installed using industry standard methods including impact hammers, vibratory hammers and jetting. The piles shall be driven either hollow or with concrete infill depending on the site-specific geotechnical conditions. The piles can also be driven either open ended or with a driving shoe as provided by Hardcore Composites. A standard pipe pile driving helmet or equivalent is used in most applications. [The method of installation and maximum allowable driving stresses shall be specified by the Engineer of Record].
- 3.02 Once the piles are installed, piles shall be cut at the cut-off elevation shown on the plans. Cutting shall be performed by sawing or other means as approved by the Engineer of Record to provide a smooth level cut.
- 3.03 Depending on the physical properties required, piles may be left unfilled. If the project requires the piles be filled, soil and water shall be removed from the inside of the pile to below the point of fixity or as specified by the Engineer of Record. Concrete or other filler material shall then be tremmie placed into the pile in a manner approved by the engineer. [Engineer to determine whether filled or unfilled piles are required].
- 3.04 When submitting shop drawings for approval, the provisions of the applicable state or federal specifications shall apply, with the following modifications:
- A. The Contractor shall submit the following shop drawings and supporting information for approval:
- i. Proposed FRP composite tube, including bending stiffness and bending moment, concrete specification and certification of compliance with this specification.
  - ii. Proposed concrete mix design, verifying compressive strength and shrinkage compensation.
  - iii. Details for driving helmets, cap blocks and pile cushions and recommendations for pile driving equipment.
  - iv. Handling, transporting and storing recommendations for composite piles.
  - v. Proposed concrete supplier.

### **4. METHOD OF MEASUREMENT**

The quantity of piles to be paid for under the work specified for FRP Composite Piles will be the number of linear feet of piles placed in the leads, and installed in accordance with the plans and this specification. No additional measurement for payment will be made for redriving of piles that are forced up by any cause.

**FRP COMPOSITE PILES****5. BASIS OF PAYMENT**

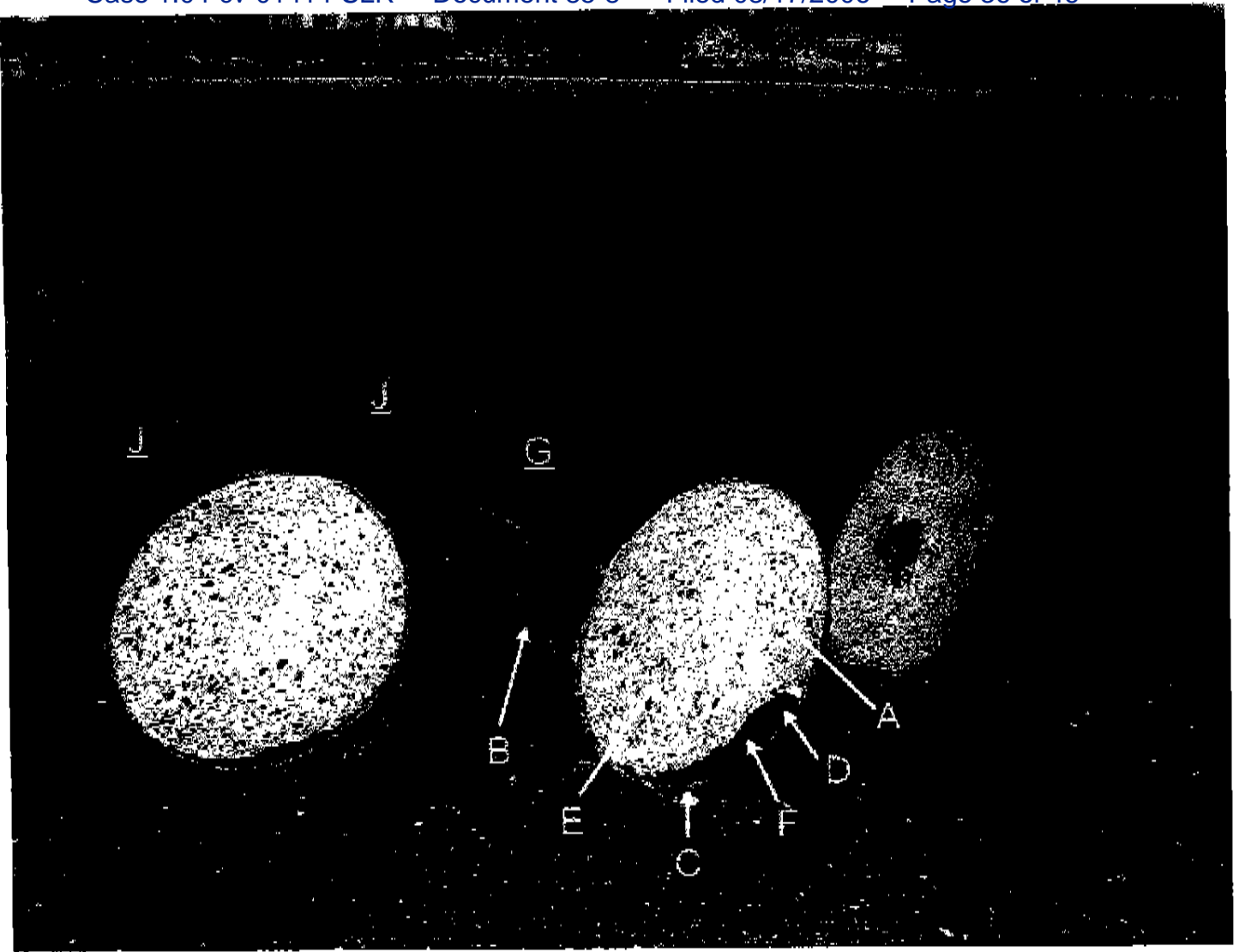
5.01 The unit price bid per linear foot for each of the respective FRP Composite Pile items shall include the cost of furnishing all labor (including the manipulation of pile driving equipment and materials), materials, and equipment necessary to complete the work as prescribed in these specifications. No payment will be made for piles rejected in accordance with the requirements listed under sections regarding Defective Piles of the applicable state or federal specifications.

5.02 Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Pay Unit</u>
10-2	FRP Composite Pile (2-ply), 10" Dia.	LF
12-2	FRP Composite Pile (2-ply), 12" Dia.	LF
12-3	FRP Composite Pile (3-ply), 12" Dia.	LF
14-3	FRP Composite Pile (3-ply), 14" Dia.	LF
18-3	FRP Composite Pile (3-ply), 18" Dia.	LF
18-4	FRP Composite Pile (4-ply), 18" Dia.	LF
24-3	FRP Composite Pile (3-ply), 24" Dia.	LF
24-4	FRP Composite Pile (4-ply), 24" Dia.	LF



**Hardcore Composites**  
618 Lambsons Lane / New Castle, DE 19720  
Phone: 302.442.5900 / Fax: 302.442.5901  
[www.hardcorecomposites.com](http://www.hardcorecomposites.com)



IMG 0413



**Exhibit E**

IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF DELAWARE

LANCASTER COMPOSITE, INC.,  
Plaintiff,

Civil Action No. 04-1414 SLR

v.

HARDCORE COMPOSITES OPERATIONS, LLC  
and W. SCOTT HEMPHILL,  
Defendants.

**AFFIDAVIT OF DOUGLAS F. SUESS, P.E.**

I, Douglas F. Suess being duly sworn according to law depose and say as follows::

1. I am an Executive Vice President of Whitney Bailey Cox and Magnani, LLC, a full service consulting engineering/architectural firm.
2. I am a graduate of the University of Maryland with both Bachelors and Masters degrees in Structural Engineering.
3. I am a registered Professional Engineer with over 30 years of experience in the design of building and marine structure
4. I have designed and managed projects for marginal wharfs and piers, reefer terminals, tieback bulkheads, the rehabilitation of existing marine structures, and building support facilities.
5. I served as past president of both the American Council of Engineering Companies (ACEC) of Maryland and the Maryland Chapter of the American Society of Civil Engineers (ASCE) and am a Fellow in ACEC.
6. I have taught Professional Engineering review courses for the University of Maryland, Baltimore County.

7. I have been previously retained and engaged as an expert witness in several matters.
8. I have been recognized by a court and testified as an expert witness in at least one matter.
9. I am familiar with Hardcore composite tubular pilings as a result of an in house seminar presented to our firm on the Hardcore product as well as a review of their literature.
10. I have reviewed Lancaster Composite's U.S. Patent Nos. 5,800,889 and 6,048,594.
11. I have reviewed claim charts including attachments prepared by Barley Snyder for Lancaster Composite U.S. Patent Nos. 5,800,889 and 6,048,594 relative to the Hardcore products and I concur with those readings of claims on the Hardcore's products. Specifically, Hardcore's composite tubular pilings include each the elements recited in the claims listed in the claim charts. My concurrence of those claim readings is based on sound engineering principles and my familiarity with the Hardcore products.

Sworn to and Subscribed  
before me this 30th day  
of December, 2004.

  
Notary Public

  
Douglas F. Suess

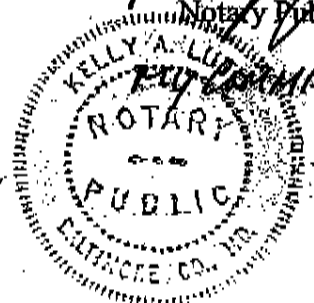


Exhibit F

IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF DELAWARE

LANCASTER COMPOSITE, INC.,  
Plaintiff,

Civil Action No. 04-1414 SLR

v.

HARDCORE COMPOSITES OPERATIONS, LLC  
and W. SCOTT HEMPHILL,  
Defendants.

**AFFIDAVIT OF ROBERT H. GREENE**

COMMONWEALTH OF PENNSYLVANIA :

:

SS:

COUNTY OF LANCASTER :

:

I, Robert H. Greene, being duly sworn according to law depose and say as follows:

1. I am the President of Lancaster Composite, Inc. ("Lancaster Composite"), Plaintiff in the above matter, and I have personal knowledge of the facts set forth in this Affidavit.

2. The photographs attached to this Affidavit as IMG0413 and IMG0414 were photographs I personally took in April, 2003 on the docks at the Belmar Municipal Marina in Belmar, New Jersey. These photographs are two in a series of six I took on the same day in April, 2003. One or both of the photographs attached to this Affidavit have been attached to and are referred to in the Claims Charts prepared by Lancaster Composite's counsel.

3. The photographs depict Hardcore pilings which were, at the time of the photographs, in storage for construction of a new fuel dock at the Belmar Municipal Marina.

4. The Belmar Municipal Marina Project and the Hardcore pilings photographed are the subject of the initial suit brought by Lancaster Composite against Hardcore Composites Operations, LLC ("Hardcore Composites") in this Court, indexed at CA No. 03-840 (SLR).

5. Since Hardcore Composites has been a direct competitor of Lancaster Composite, I have, on many occasions, observed Hardcore pilings in great detail. Furthermore, I have in my possession pieces of Hardcore pilings. Therefore, I am quite familiar with Hardcore pilings.

6. The Hardcore piling tube is easily recognized by the textured fabric that comprises a red-colored inner wall of the piling. The pilings depicted in these photographs contain the textured fabric comprising a red-colored inner wall.

7. The Hardcore piling tube is produced by the VARTM process. The filing ports utilized in this process were visible to me when I observed these pilings at the Belmar Municipal Marina and can be seen in the photographs.

8. Hardcore is the only piling company to produce its fiberglass tubes by the VARTM process.

9. Hardcore is the only competitor of Lancaster Composite whose piling is of the same design and type as Lancaster Composite.

10. In addition to my personal observations, I confirmed through the owner's representative, Birdsell Engineering, that the pilings at the Belmar Municipal Marina were manufactured by Hardcore Composites.

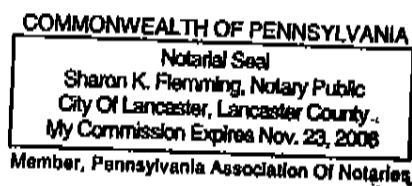
11. The pilings depicted in these photographs are Hardcore pilings. Furthermore, the pilings depicted in these photographs are representative of the infringing pilings manufactured, sold, and offered for sale by Hardcore Composites.

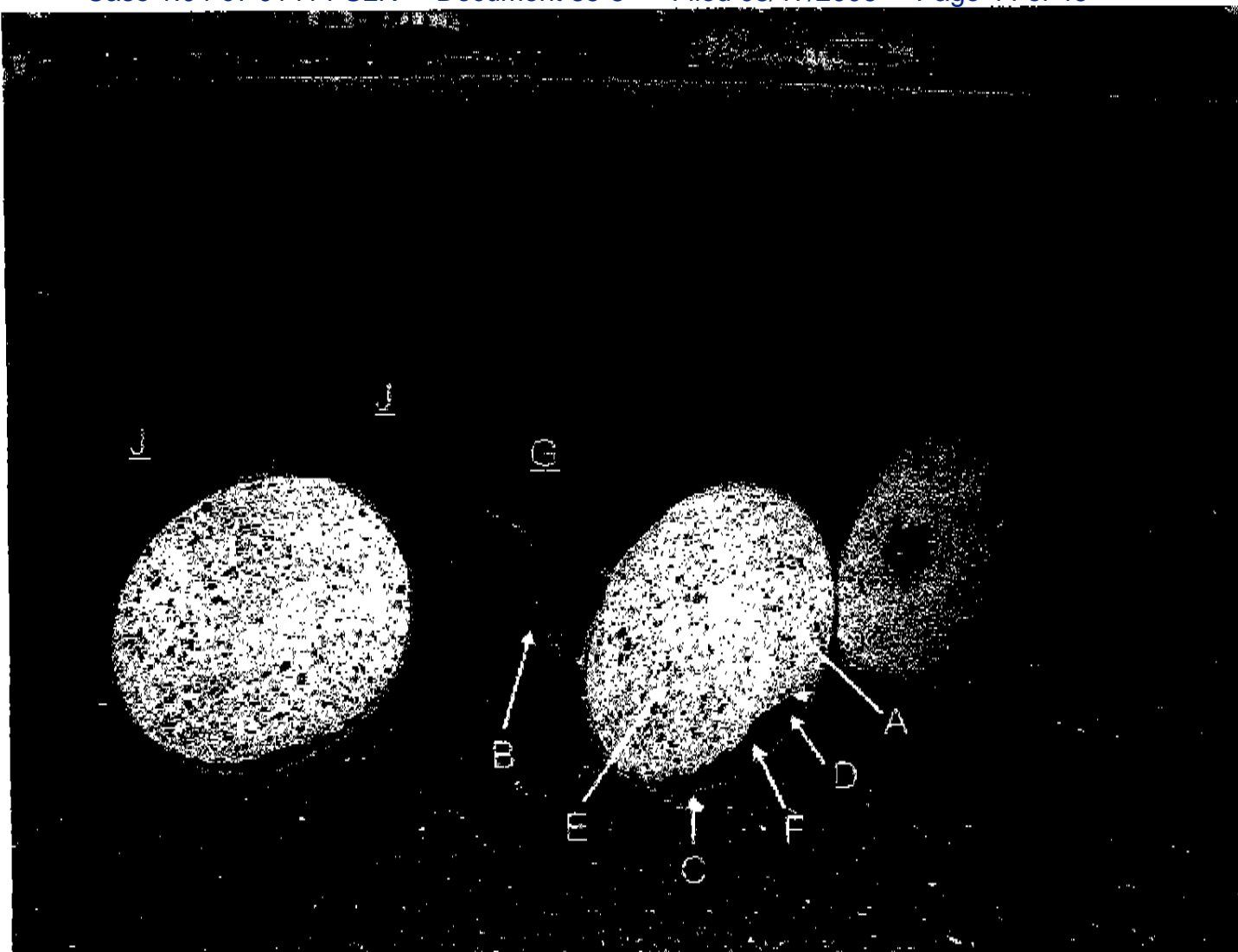
Sworn to and Subscribed  
before me this 27th day  
of December, 2004.

Sharon K. Flemming  
Notary Public

By: Robert H. Greene

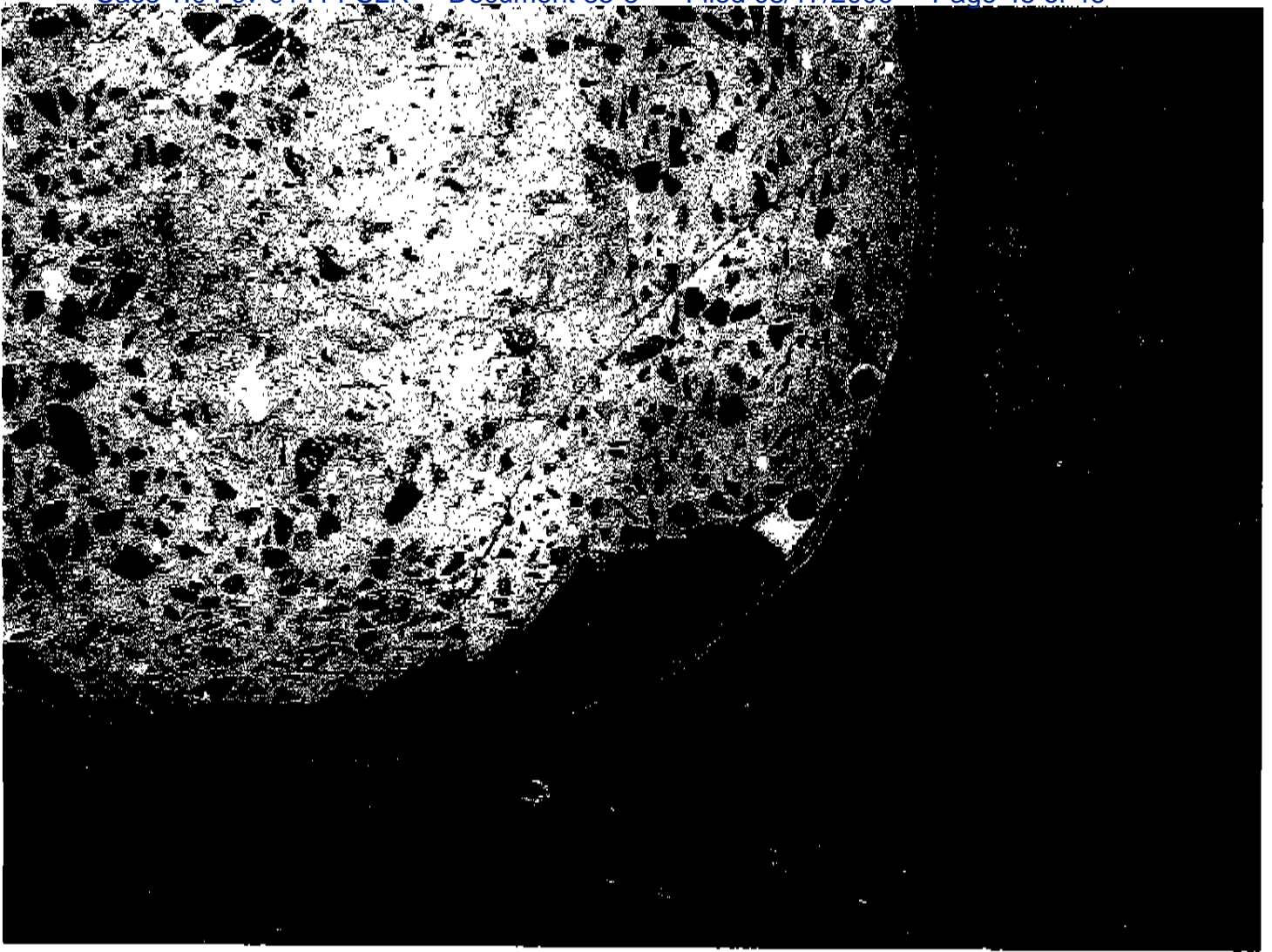
Robert H. Greene





IMG 0413





IMG 0414

**CERTIFICATE OF SERVICE**

I, Kevin A. Guerke, Esquire, hereby certify that on August 17, 2006, I caused a copy of the foregoing *Appendix in Support of Motion of Plaintiff Lancaster Composite, Inc.'s Motion for Partial Summary Judgment on Patent Infringement Against W. Scott Hemphill* to be served via U.S. First Class Mail upon the following:

W. Scott Hemphill  
517 Riblett Lane  
Wilmington, DE 19808

/s/ Kevin A. Guerke

By: \_\_\_\_\_

Kevin A. Guerke, Esquire (#4096)  
kguerke@svglaw.com